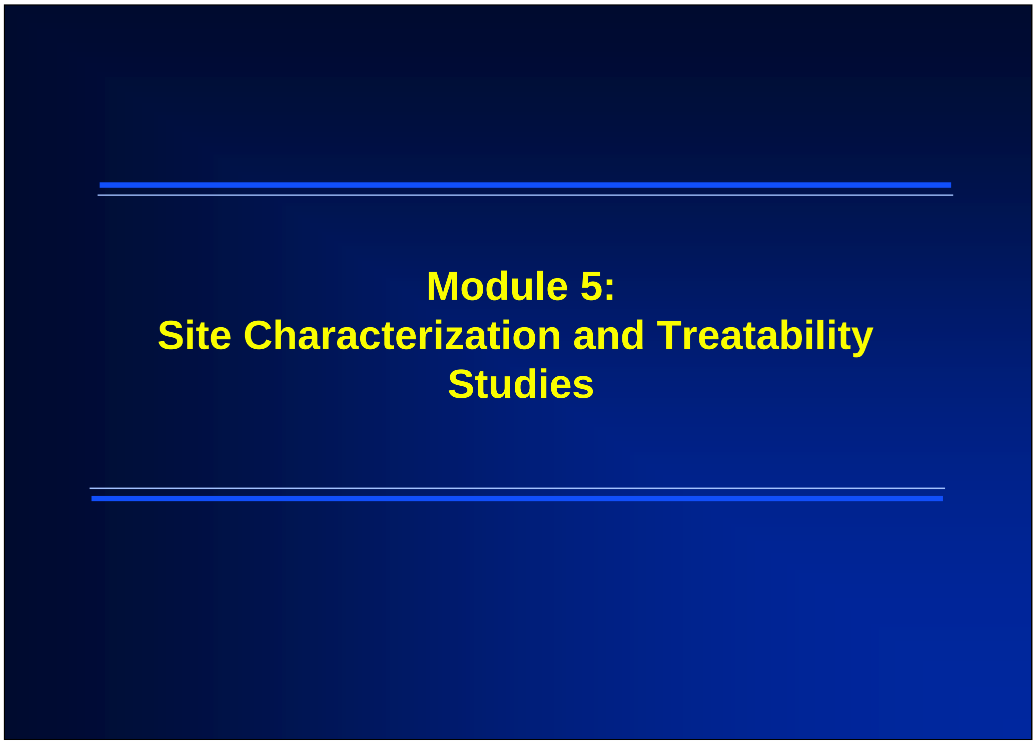


- This section discusses activities associated with site characterization and treatability studies, including field investigations, data analysis, and defining the nature and extent of contamination. It also addresses the management of the site characterization and treatability study aspects of the RI.

- Key references for this section include:

    - *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, Interim Final, EPA, OSWER Directive 9355.3-01, October 1988.

    - *Guide for Conducting Treatability Studies under CERCLA*, Interim Final, EPA 540/2-89/058, December 1989.

    - *Treatability Studies under CERCLA: An Overview*, EPA, OSWER Directive 9380.3-02FS, December 1989.

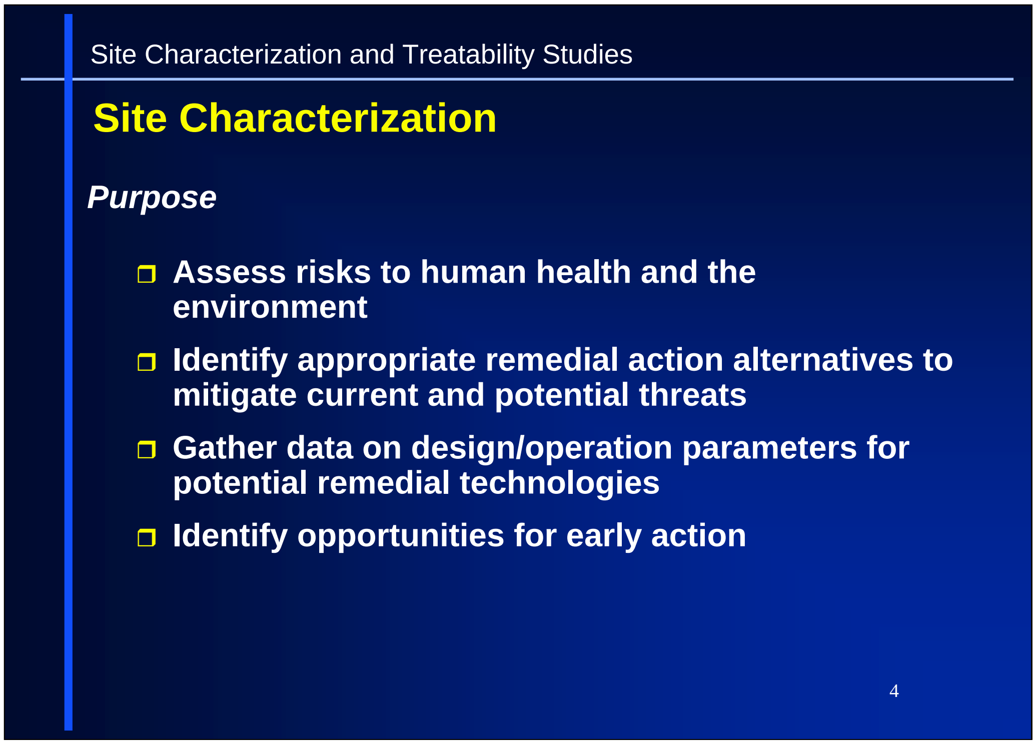
    - *The Remedial Investigation: Site Characterization and Treatability Studies*, EPA, OSWER Directive 9355.3-01FS2, November 1989.

Module Objectives

- **Identify the four principles of environmental restoration**
- **List the activities that should occur in support of site characterization**
- **Identify the types of data that must be obtained to define a site's physical characteristics, characterize sources of contamination, and model contaminant fate and transport**
- **Explain how data collection decisions should be driven by the decision-making needs of the RI/FS**
- **List the situations that define when site characterization is adequate or complete**
- **Explain why communication between site manager and EPA is important during the RI/FS**

Module Objectives (con’t)

- List site characterization deliverables
- Identify the purpose and importance of treatability studies
- Compare and contrast bench testing and pilot testing treatability studies
- Explain the RCRA sample exclusion rule

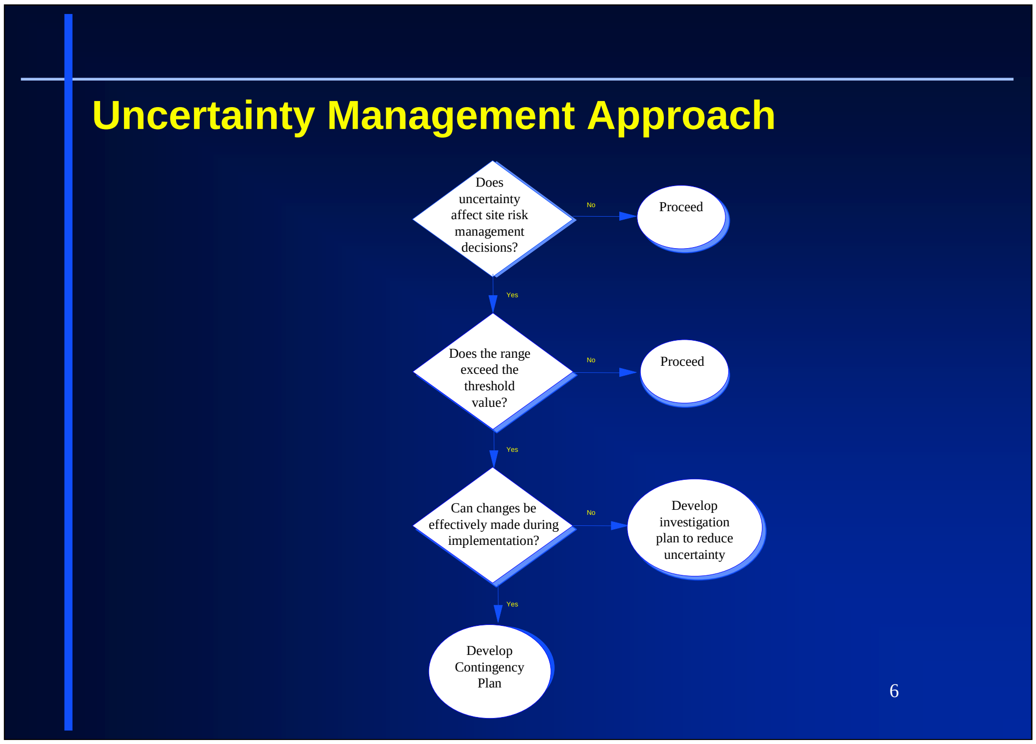


- The overall objective of site characterization is to define and describe (characterize) areas that pose a threat to human health and the environment. This includes identifying and characterizing toxicity levels and determining contaminant fate and transport.

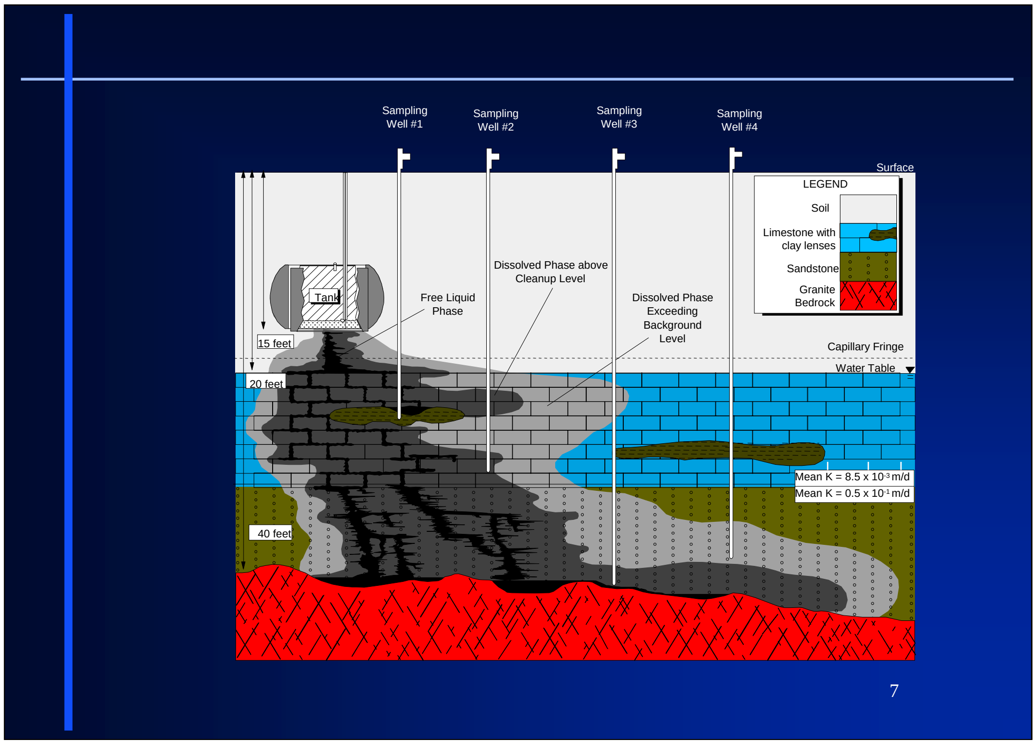
- *Remember:* Site characterization activities should be performed concurrently with FS activities. Data needed to evaluate alternatives should be collected during site characterization. Data needs should be progressively refined as more detail is developed concerning your alternatives.

Problem statements and likely response actions: leaking tank example

Problem Statement(s)	Likely Response Actions
1. Underground storage tank releasing TCE and Tc-99 to environment	a. Remove tank b. Remove contents of tank and grout tank in place
2. TCE and Tc-99 released to subsurface soils in excess of regulatory criteria.	a. Remove contaminant from soils contaminated in excess of regulatory criteria b. Remove soils contaminated in excess of regulatory criteria
3. Free-liquid phase and dissolved phase plumes exceed ground water cleanup levels of 5 ppb TCE and 300 pCi/L Tc-99	a. Control plume migration using pump and treat b. Conduct in-situ stripping of plume



- The impact of an uncertainty will correspond to a specific management approach
- The approach to managing uncertainty will include both reducing and counteracting uncertainty. The challenge is to reach core team consensus in establishing the balance between the two components



- What are the major uncertainties posed by this scenario?

Site Characterization and Treatability Studies

Categorizing impacts of uncertainties

- **Example Decision Rule: If the underground tank is continuing to release TCE and Tc-99 to the Environment, as indicated by liquid in the tank, remove tank**

Probable Condition	Reasonable Deviation	Probability of Occurrence	Time to Respond	Potential Impact	Monitoring/ Investigation	Contingency Plan
Saturated soil conductivity expected to be 10E (-4) cm/s	Conductivity likely to range from 10E(-2) to 10E(-7) cm/s	High. (based on existing hydrogeologic data)	Long.	Low. May impact the drainage of rainwater if < 10E (-4) cm/s	N/A	Insignificant. No impact on likely response action.
Soil is expected to be stable (i.e., greater than Class C)	Soil may be unstable (i.e., slump slope < 50% or soil is less stable than Class C)	Low. (based on results of previous slump tests)	Short. (excavation face may sluff or cave in)	High. -Threat to worker safety - Could increase cost or delay schedule	Conduct visual inspection and additional slump tests	Significant -Shore walls - Lay back excavation
Tank and its contents are expected to be low-level waste	Subtitle C debris management rule may be applicable (i.e., tank/contents could be hazardous or mixed waste)	Medium. (based on process knowledge)	Short. (to prevent excavation from being delayed)	High. - May delay excavation - May increase disposal costs and change handling requirements	Sample and analyze tank contents; compare results to regulatory criteria	Significant. Develop contingency plans for excavation, storage, and disposal of hazardous wastes; analyze cost impacts to ensure available funding.

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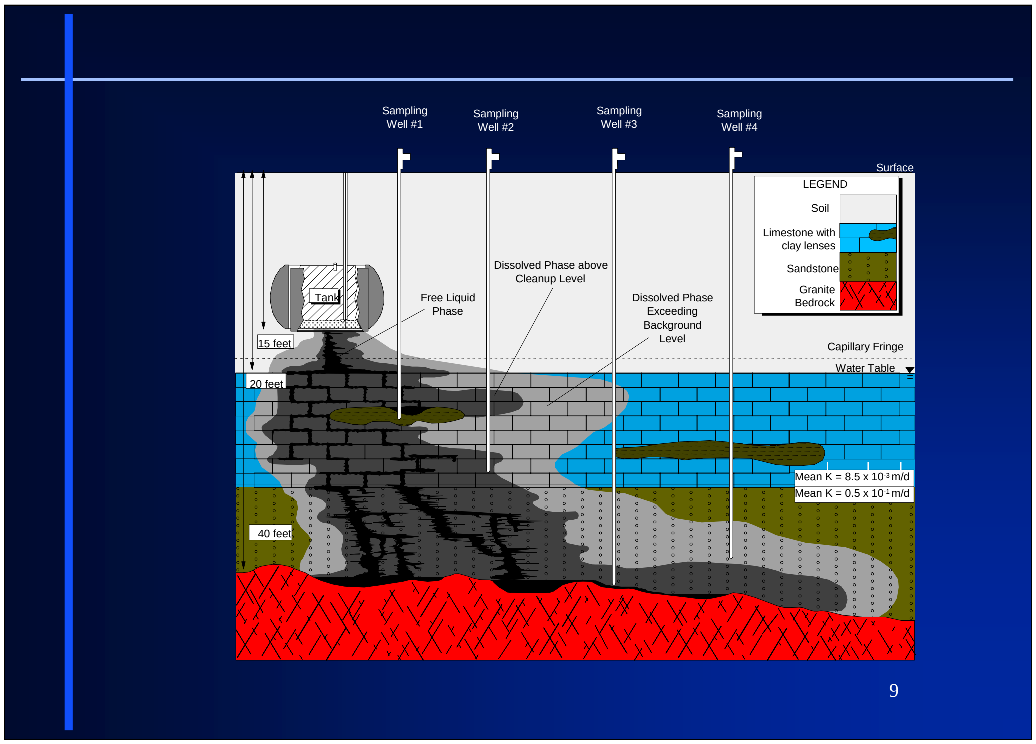
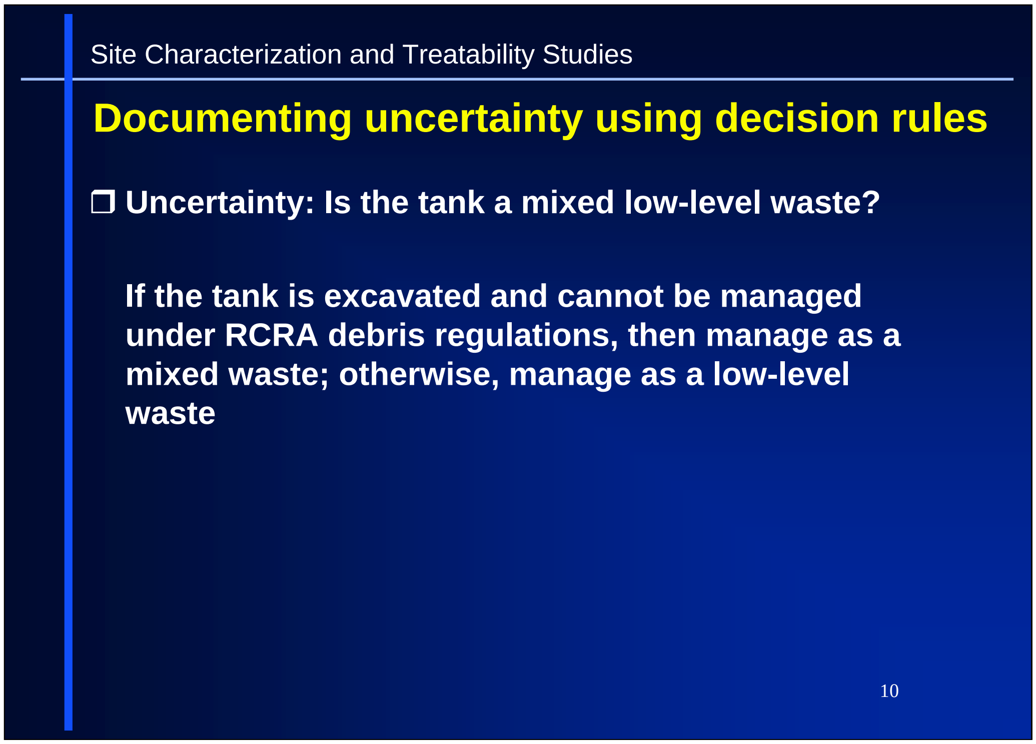
- The matrix above focuses on uncertainties associated with the implementation of a likely response action, and illustrates the classification of identified uncertainties into the categories listed below:
  - Uncertainty insignificant to ultimate objective
  - Uncertainty must be reduced with more data
  - Uncertainty, but can be managed by contingency plan
- Probable condition identifies nature of the uncertainty that exists
- Reasonable deviation from the expected condition is a quantitative or qualitative expression of uncertainty
- Probability that a deviation will occur, timeframe to respond to a deviation, and potential impacts of a deviation on the likely response are all considered in evaluating uncertainty
- Monitoring/Investigation are the kinds of observations or measures that will be taken to determine the existence of an expected condition or reasonable deviations
- Contingency plan documents how an uncertainty will be managed - either by reducing it or developing a contingency plan



- For this scenario, would you want to <u>manage</u> or <u>reduce</u> the following uncertainties?
  - Level of water table relative to tank
  - Location of TCE pools
  - Contents of the tank (i.e., Are contents present? What are their physical nature and regulatory status?)
  - Condition of the tank

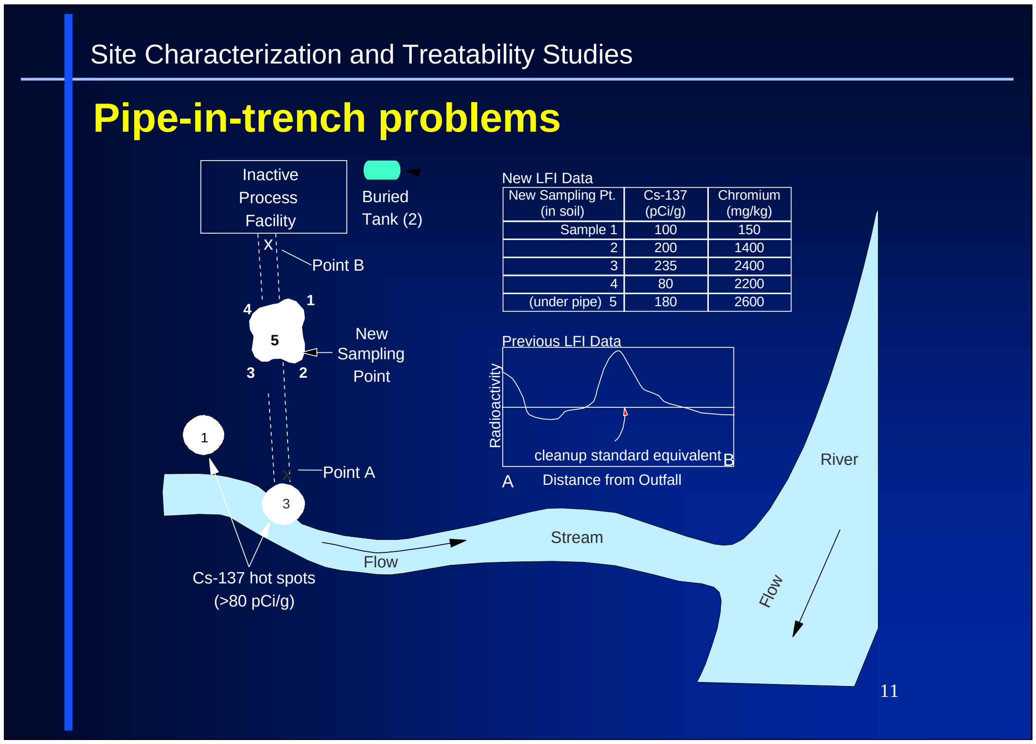


- As with problem definition and early identification of response actions, decision rules can be used to document uncertainties, particularly when the decision is to manage by contingency plans

- RCRA Debris rule allows most types of debris containing hazardous wastes to be treated using appropriate technologies and, following treatment, be rendered non-hazardous

- In this case, if the debris rule was able to be applied to the tank, the tank would be considered to be low-level waste following treatment rather than mixed waste

- The determination of whether the tank could be managed under the debris rule would involve (1) status of the debris rule under State hazardous waste regulations; (2) technical ability to manage the contaminated tank using the appropriate technologies. For example, if a tank were corroded or not intact, washing technologies to remove hazardous wastes may not be technically appropriate?



- Problem 1: Pipe containing sludges that could provide a continuing source of Cs-137 to surface soils and stream sediment in concentrations greater than health-based levels

- Likely Response Actions:
  - Remove the sludges contaminated from the pipe in excess of regulatory or health-based levels
  - Grout pipe
  - Remove pipe

- Problem 2: Cs-137 and chromium released to soil in excess of health-based and regulatory levels

- Likely Response Action:
  - Excavate soils containing Cs-137 and chromium in excess of regulatory levels

Uncertainty matrix for pipe-in-trench example

Probable Condition	Reasonable Deviation	Probablitliy of Occurrence	Time to Respond	Potential Impact	Monitoring/ Investigation	Contingency Plan

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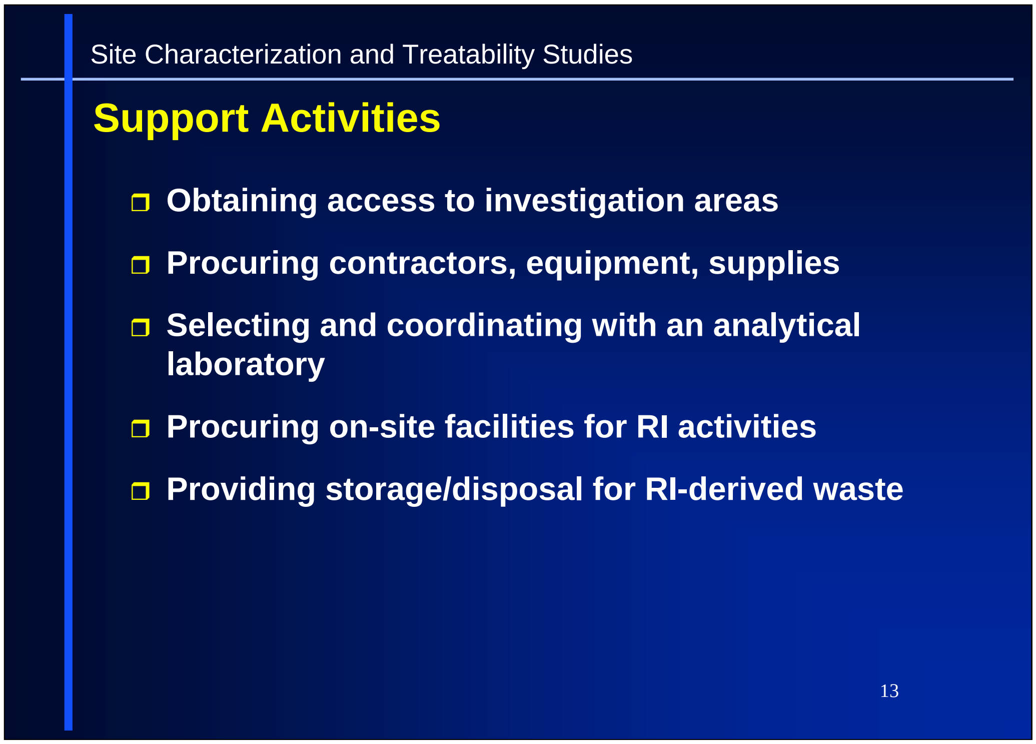
•Fill out the matrix above for the pipe-in-trench example outlined on the previous page.



- Ensure that access to the site and any other areas to be investigated has been obtained. Consider weather conditions when scheduling field activities: extreme weather conditions may delay the schedule. Off-site access may be a problem, as could access to classified areas, or areas where other activities are occurring.

- Procure subcontractors such as drillers, excavators, surveyors, and geophysicists. Ensure that field contractors are trained in CLP procedures, including sample collection, shipment, and chain-of-custody requirements, to minimize the need to resample. Work closely with your procurement staff to ensure personnel are on-board when they are needed.

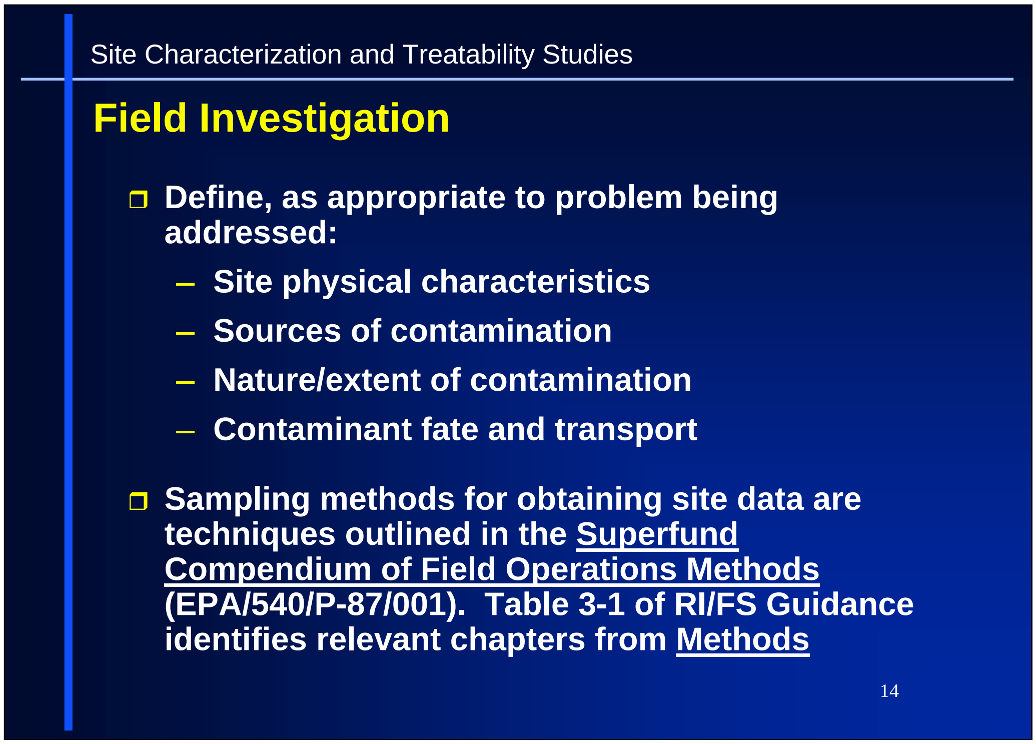
- Coordinate with analytical laboratories on issues such as sample scheduling, reporting, chain-of-custody records, and sample bottle acquisition.

- Subcontract and lab needs should be identified early -- particularly if competitive bidding is required.

- Procure on-site facilities for offices, on-site laboratories, decontamination, equipment and vehicle maintenance and repair, and sample storage.

- Provide for storage or disposal of contaminated material such as disposable equipment, decontamination solutions, and drilling muds. The handout package that accompanies this course contains a fact sheet on disposing of investigation-derived waste.

- Since any procurement activities can take several months, plan and initiate them as early as possible.

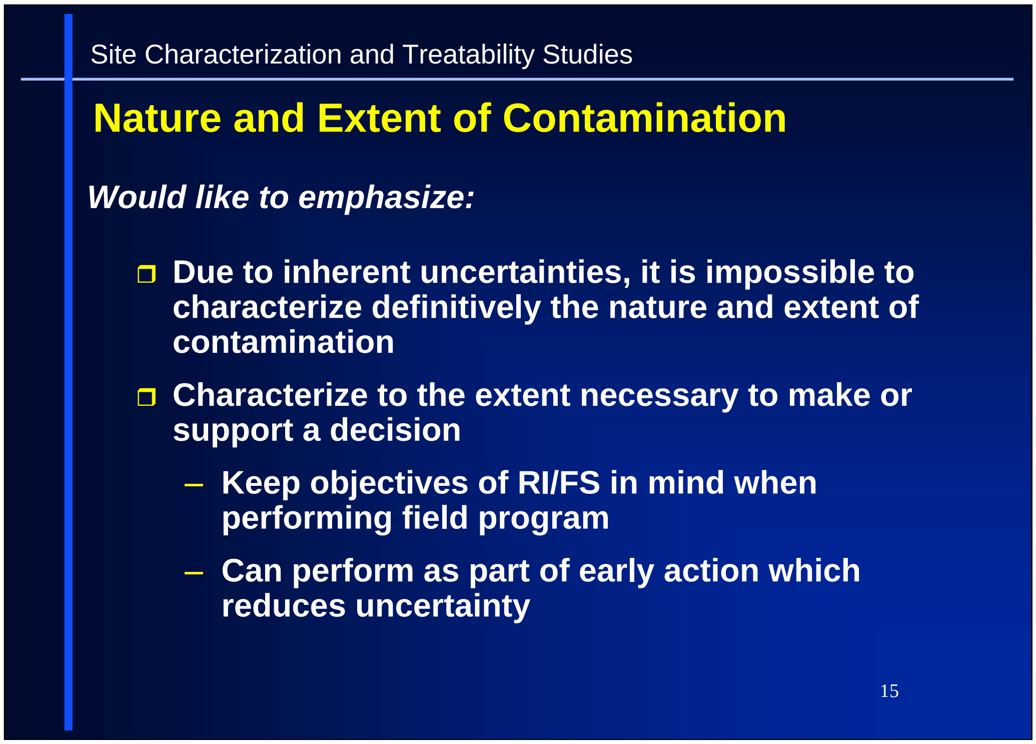


- Data on the site's physical characteristics are collected to (1) define potential transport pathways and receptor populations and (2) provide sufficient engineering data to develop and evaluate remedial action alternatives.

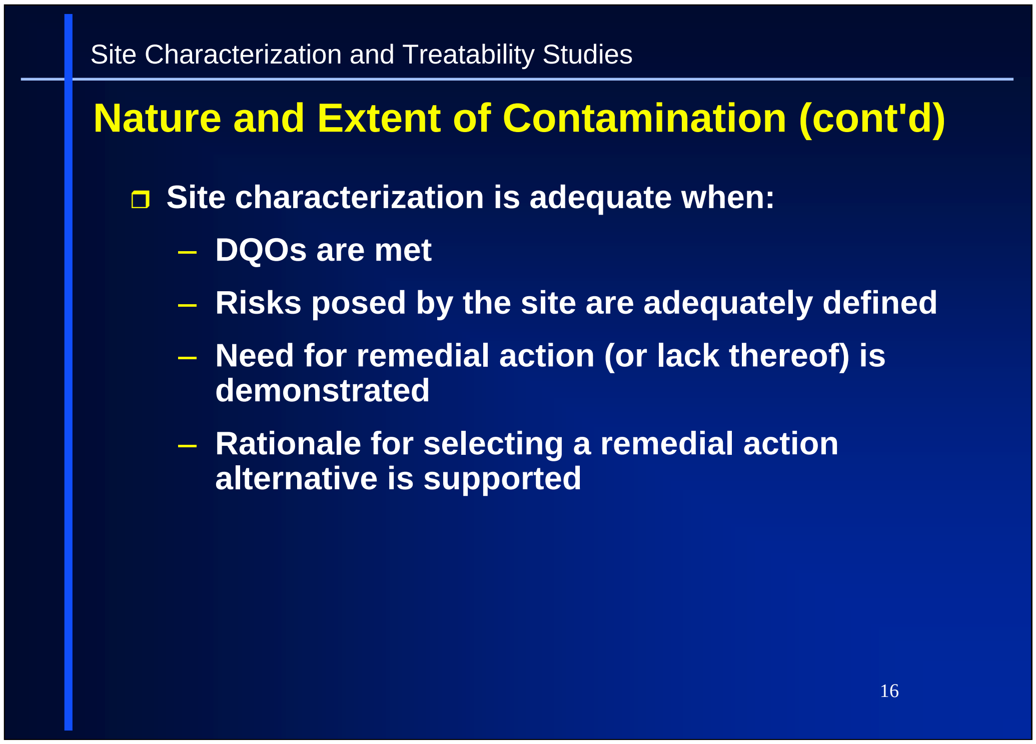
- Information used to define a site's physical characteristics includes:
  - site surface features
  - site geology
  - soil and vadose-zone characteristics
  - site hydrogeology
  - surface water hydrology
  - ecological information

- Characterizing sources of contamination includes defining (1) facility characteristics that identify source locations; (2) the quantity of wastes that are either contained in or have been released in the environment; and (3) the physical and chemical characteristics of wastes present in the sources.

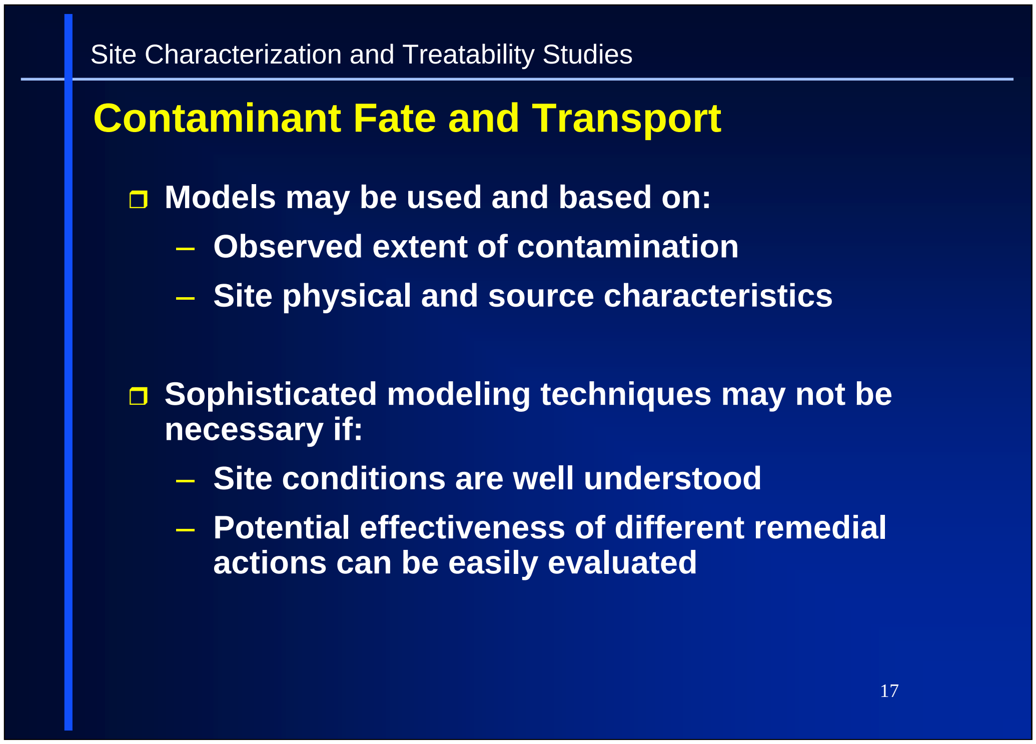
- Nature and extent of contamination and contaminant fate and transport are discussed on the following pages.



- Characterizing the nature and extent of contamination involves using the information on physical site data and source location for a preliminary estimate of the locations of contaminants that may have migrated into the environment. An iterative monitoring program is often implemented so that the locations and concentrations of contaminants that have migrated can be defined.
- The amount of data collection depends on a trade-off between better characterization and costs.
- The type of data collected should be objective-driven. For example, soil vapor data are valuable when soil vapor extraction is anticipated. This requires foresight and planning so that repetitive sampling is not needed.



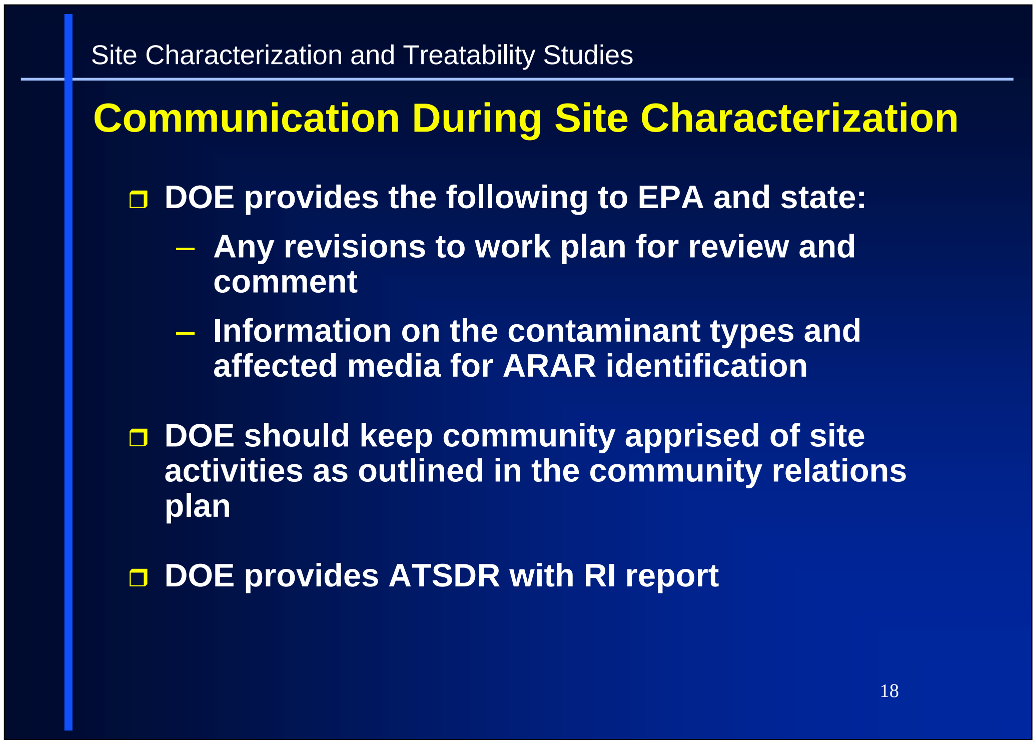
- The sampling and analysis approach used to determine the extent of contamination is discussed in EPA's *Data Quality Objectives for Remedial Response Activities*, March 1987, OSWER Directive 9335.0-7B.



- Determining contaminant fate and transport involves determining the actual and potential magnitude of releases from the sources and the mobility and persistence of source contaminants.

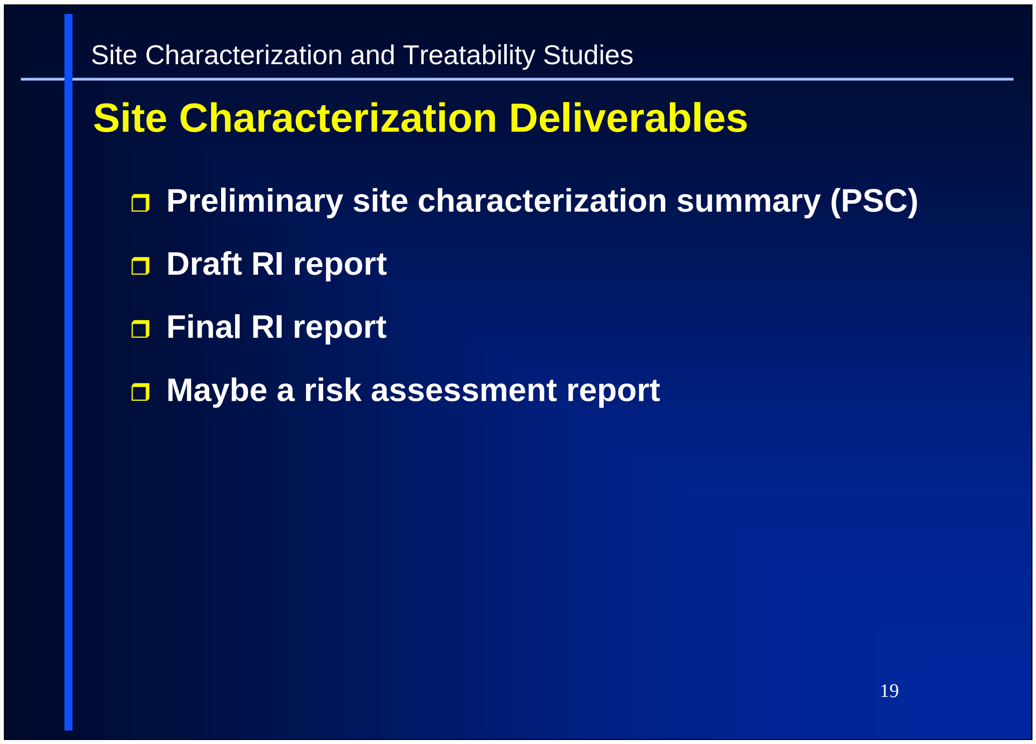
- Modeling of some type is always required. At a minimum, a simple conceptual model of the site is needed. In some cases, sophisticated models may be required.

- Consideration of modeling is required early in scoping to establish appropriateness of models for the site. There must be adequate data of appropriate quality to ensure the validity of a model's results.



- Communication about innovative ideas early on is important. Agencies are often nervous about innovation (e.g., X-ray fluorescence). With early communication, agencies may agree to monitored trial tests that can increase use of successful methods later.

- Communication should be frequent and may be in the form of phone calls, informal memos, or meetings.



- The PSC is a concise summary of site data. It provides a vehicle for early sharing of ARARs with the support agency, allows for early refinement of remedial alternatives, and can be transmitted to ATSDR so they can begin their health assessment.

- The PSC may be a list of contaminants and affected media, or it may be more extensive and address investigative activities.

- The draft RI report summarizes the results of the field activities to characterize the nature and extent of contamination, the fate and transport of contaminants, and the results of the baseline risk assessment.

- The final RI report incorporates EPA and support agency comments.

- The requirements of an RI report can be found in the RI/FS Guidance.

Site Characterization and Treatability Studies

Treatability Studies

- Treatability studies conducted during RI/FS are generally used to:
  - Determine whether a technology can achieve the remedial action goals that will be specified in the Record of Decision (ROD)
  - Provide information to support detailed analysis and remedy selection
- Treatability studies conducted during Remedial Design/Remedial Action (RD/RA) are generally used to:
  - Verify that the technology can achieve ROD goals
  - Optimize design and operating conditions
  - Improve cost estimates

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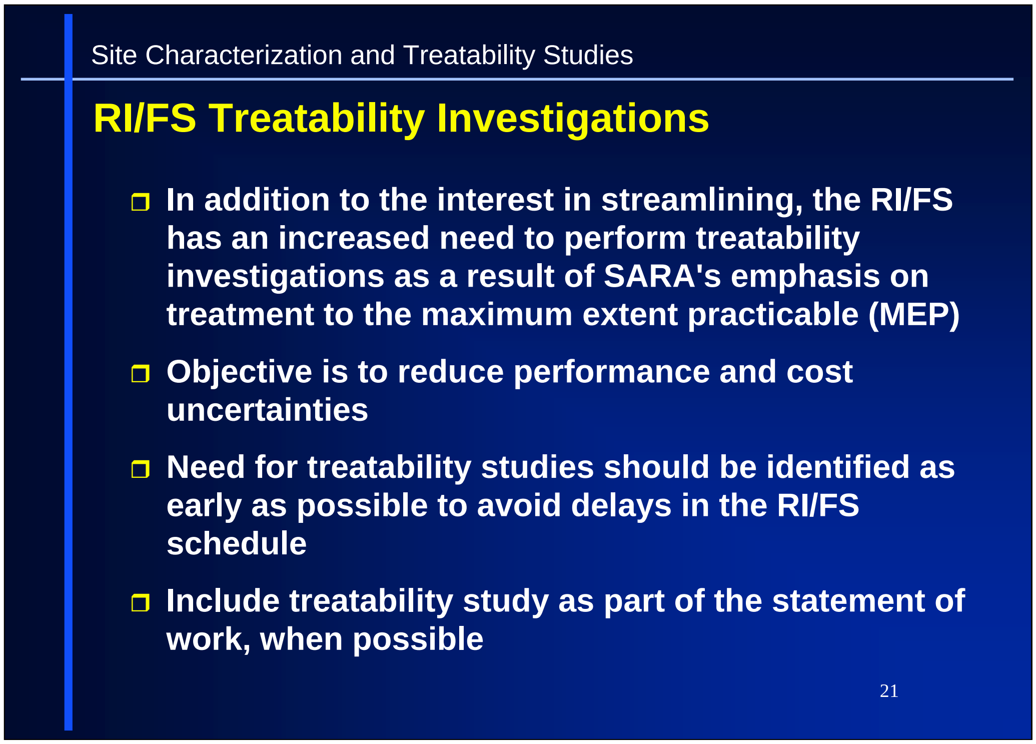
- A number of EPA and DOE treatability study initiatives have been undertaken to streamline the RI/FS process.

- The focus of these initiatives has been to identify the need for treatability studies during scoping and to design and implement treatability studies during the RI/FS. Some form of treatability study is usually warranted if technologies involving treatment have been identified as potential remedial actions.

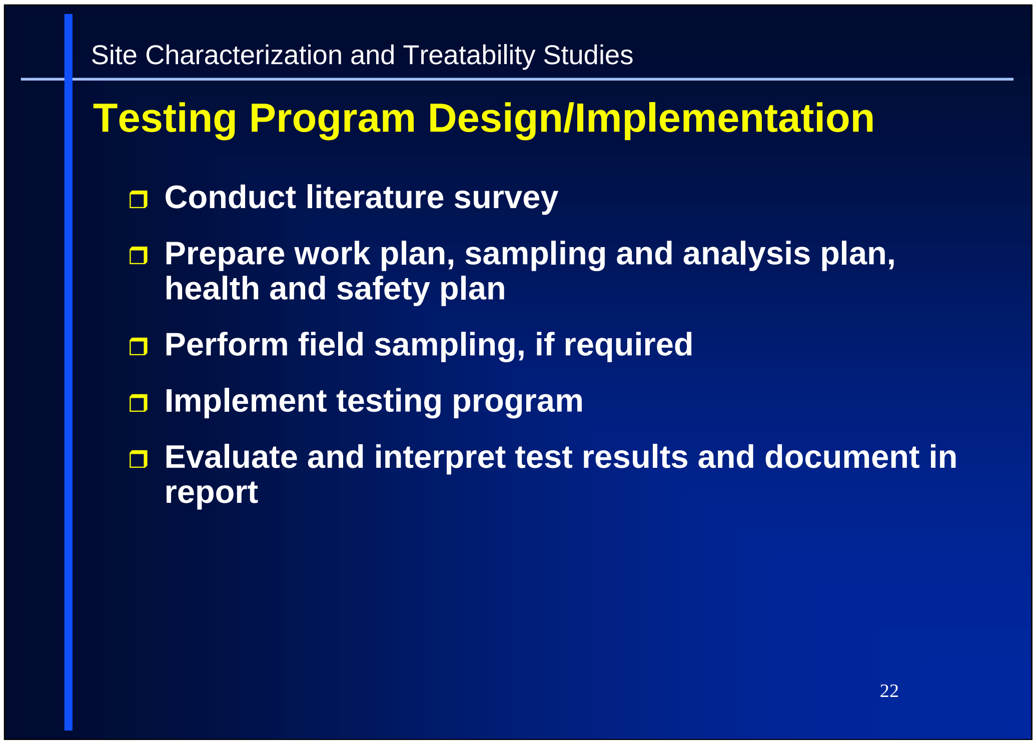


- The treatability study is also conducted to reduce treatment alternative cost and performance uncertainties to acceptable levels so that a remedy can be selected.

- The decision to conduct treatability testing may be made during project scoping if information indicates such testing is desirable. In some situations, a specific technology that appears to offer a substantial savings in costs or significantly greater performance capabilities may not be identified until the later phases of the RI/FS. Under such circumstances, it may be advantageous to postpone completion of the RI/FS until treatability studies can be completed.

- Some technologies always require treatability testing:
  - Stabilization -- reagent blend
  - Soil washing -- solvent efficiency
  - Vitrification -- glass quality

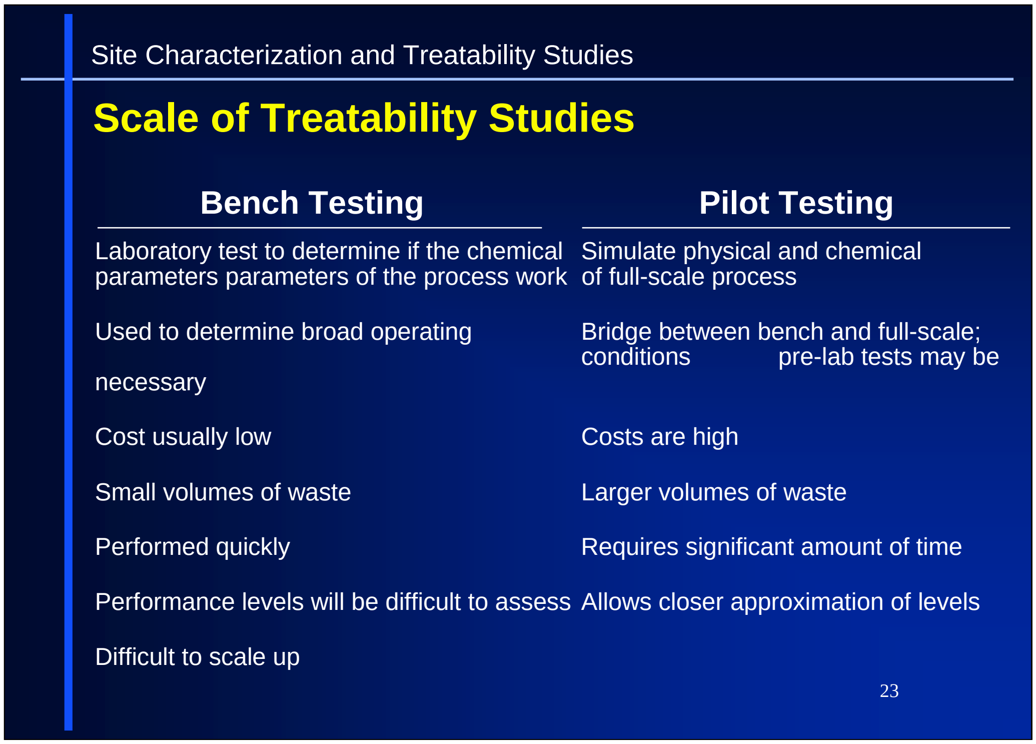
- These are generally innovative technologies.



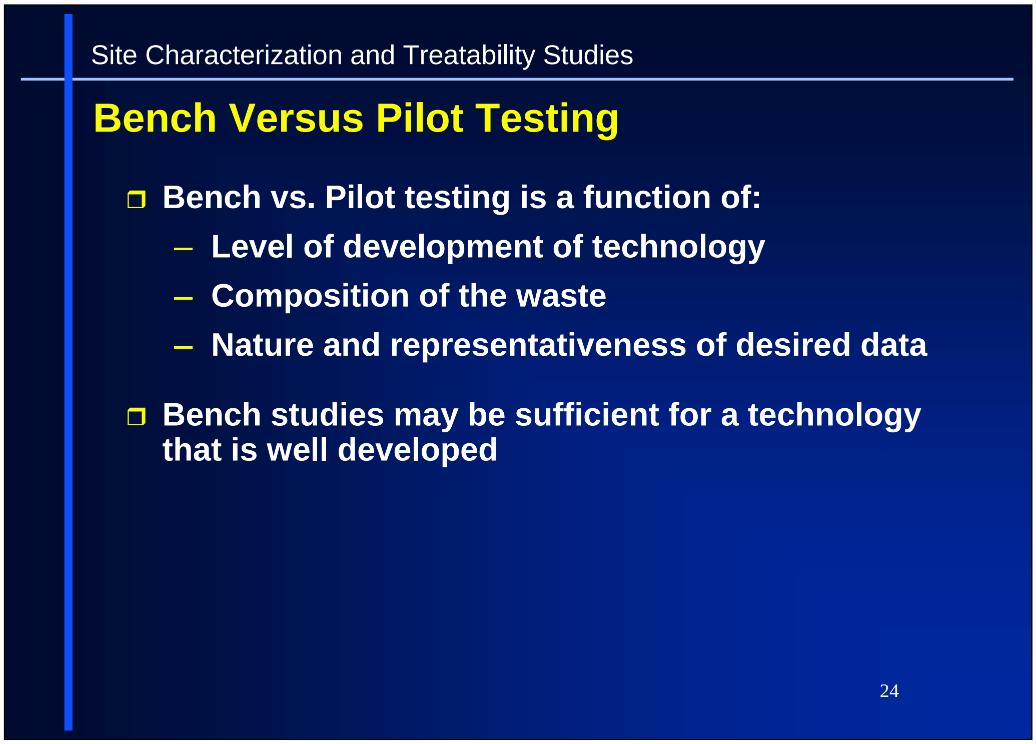
- Certain technologies have been demonstrated sufficiently so that site-specific information collected during site characterization is adequate to evaluate and cost those technologies without conducting treatability testing. For example, a groundwater investigation usually provides sufficient information for which to size a packed tower air stripper and prepare a comparative cost estimate.

- The need for treatability testing should be identified during project scoping to avoid delays in the RI/FS schedule. During scoping, a literature survey should be conducted to gather information on a technology's applicability, performance, etc.

- If practical candidate technologies have not been sufficiently demonstrated or cannot be adequately evaluated based on available information, treatability testing should be performed.



- Bench testing usually is performed in a lab, where comparatively small volumes of waste are tested for the individual parameters of a treatment technology.
- Bench tests are typically performed for projects involving treatment or destruction technologies.
- Pilot studies are intended to simulate the physical as well as chemical parameters of a full-scale process; therefore, the treatment unit size and the volume of waste to be processed in pilot systems greatly increase over those of bench scale.
- Pilot units are intended to bridge the gap between bench and full-scale and are intended to more accurately simulate the operation of the full-scale process than bench-scale testing.



- For a technology that is well developed and tested, bench studies are often sufficient to evaluate performance on new wastes. For innovative technologies, however, pilot tests may be required because information necessary to conduct full-scale tests is either limited or nonexistent.

- Pilot-scale studies should be limited to situations in which bench-scale testing or field sampling provide insufficient information from which to evaluate an alternative.

- Section 5.4 of EPA's *RI/FS Guidance* provides more detail on bench vs. pilot testing.

Bench Versus Pilot Testing (cont'd)

- **Pilot tests may be necessary if:**
  - **Information needed to operate the technology at full-scale is limited**
  - **There is a need to investigate secondary effects of the process**
  - **The waste being tested is complex and/or unique**

Site Characterization and Treatability Studies

Pilot-Scale Testing Considerations

- Obtaining representative samples so that results are representative of full-scale operation
- Shipment of hazardous materials
- Disposal of test residuals
- Risks to workers and community during tests

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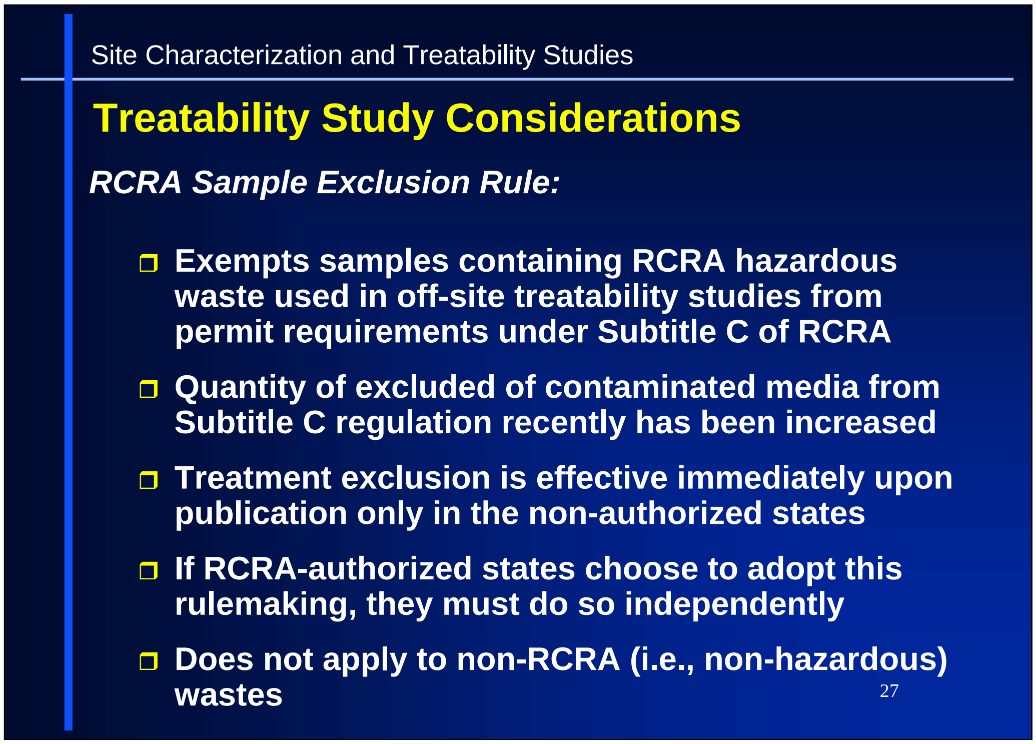
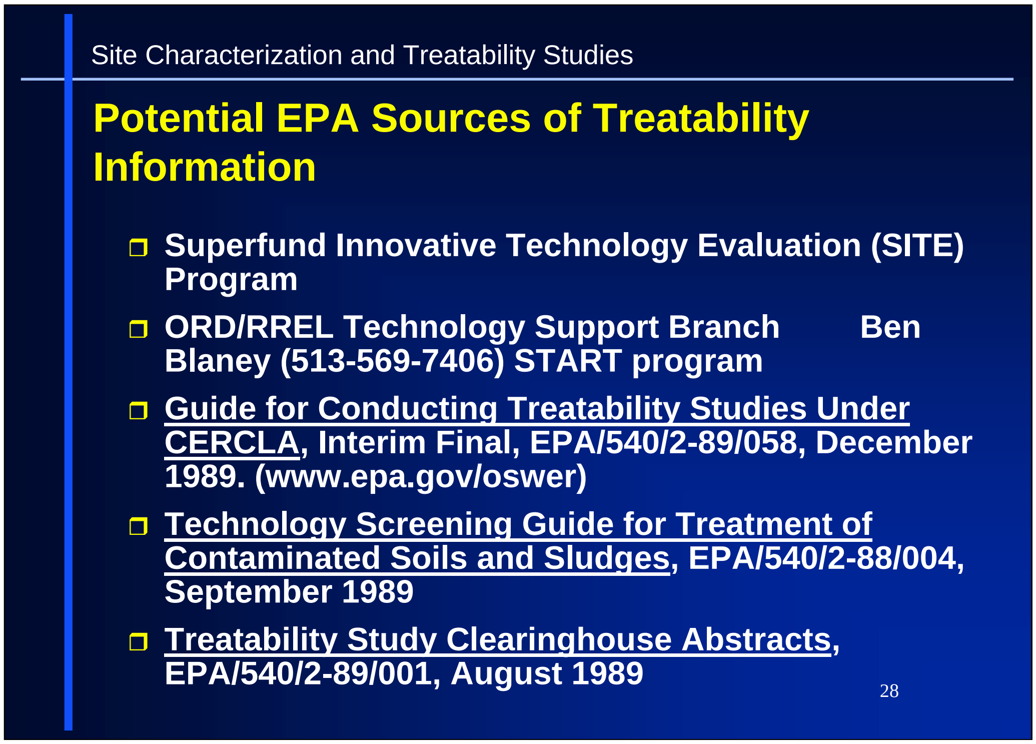
- Because substantial quantities of material may be processed in a pilot test and because of the material's hazardous nature, special precautions may be required in handling transport and disposal of processed waste. It may be necessary to obtain an agreement with a local sewer authority or cognizant state agencies or to obtain a NPDES permit for off-site discharge of treated effluent. Solid residuals must be disposed of properly or stored on site to be addressed as part of the remedial action.



- 40 CFR Parts 260 and 261 provide details on the treatability sample exemption.



- These sources generally are only appropriate for organic and inorganic constituents and are less likely to address radiological contamination.

Potential EPA Sources of Treatability Information (cont'd)

- Summary of Treatment Technology Effectiveness for Contaminated Soil, EPA/540/2-89/053, December 1989
- Treatment Technologies for Hazardous Wastes at Superfund Sites - A Guide, EPA/54-2-89/052, February 1989
- "Treatability Studies Under CERCLA: An Overview," OSWER Directive 9380.3-02FS, December 1989
- Alternative Treatment Technology Center (ATTIC), 1-800-424-9386

Module 5 Summary

- The purpose of site characterization is to define and describe areas that pose a threat to human health and the environment
- During site characterization, it is important to define, as appropriate to the site:
  - site physical characterization
  - source of contamination
  - nature/extent of contamination
  - contaminant fate and transport

Module 5 Summary (con't)

- Site characterization is adequate when:
  - DQO's are met
  - Risk posed by the site are adequately defined
  - Need for remedial action (or lack thereof) is demonstrated
  - Rationale for selecting a remedial action objective is supported
- Treatability studies are used to determine whether a technology will be successful in meeting remedial action goals. Information collected during treatability study will be used to select the remedial action.

Exercise 4:
Case Study on Scoping and Site Characterization

- **Exercise Objectives:**
  - Provides practice carrying out a site characterization
  - Reinforce the main objectives of the site characterization module

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